

CLAIMS

What is claimed is:

- 5        1. A method for updating an earth model comprising the steps of:
  - obtaining an earth model used for predicting potential problems in drilling of a borehole having a predetermined trajectory, the earth model
  - 10      comprising a plurality of components;
  - obtaining evaluations of the state of the borehole and local geological features, the evaluations being based on the earth model;
  - 15      receiving data gathered during the construction of the borehole;
  - comparing the evaluations with a diagnosis of the state of the borehole and local geological features to identify at least one inconsistency, the diagnosis being based on the received data;
  - 20      selecting a component of the earth model that is related to the identified inconsistency and has a high degree of uncertainty; and
  - updating the selected component of the earth model prior to completing construction of the
  - 25      borehole using the received data.

2. The method of claim 1 wherein the evaluations of the state of the borehole and local geological features include predictions of one or more conditions under which the borehole will fail.

3. The method of claim 2 wherein the predictions are obtained by combining the earth model with the predetermined trajectory of the borehole.

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4. The method of claim 3 further comprising repeating the steps of combining, comparing, selecting and updating until a sufficient match exists between the predicted failure conditions and the diagnoses of 10 the borehole.

5. The method of claim 4 wherein the step of combining when repeated uses the updated component of the earth model, and the step of selecting when 15 being repeated, considers components that have been recently updated as having a lower degree of uncertainty.

6. The method of claim 1 wherein the step 20 of selecting a component comprises:

identifying components of the earth model that are relevant to the identified inconsistency; and

25 ranking the identified components according to the degree of uncertainty.

7. The method of claim 1 wherein the selected component is the component having the highest degree of uncertainty of the components that are 30 related to the identified inconsistency.

8. The method of claim 1 wherein the step of updating comprises effecting the minimum practical changes to the selected component that eliminates an 5 identified inconsistency.

9. The method of claim 1 wherein the received data includes the effective density of the drilling fluid used in the construction of the borehole 10 and one at least other parameter, and the step of updating comprises updating the selected component using the effective density and the at least one other parameter.

15 10. The method of claim 1 wherein the diagnosis of the borehole is generated by extensive use of real-time MWD and LWD measurements.

11. The method of claim 1 wherein the step 20 of obtaining an earth model includes generating the earth model.

12. A method for drilling a borehole using an earth model comprising the steps of:  
25 obtaining an earth model used for predicting potential problems in drilling of a borehole having a predetermined trajectory comprising a plurality of components;  
predicting one or more conditions under which 30 the borehole will fail based on the earth model and the predetermined trajectory;

drilling part of the borehole substantially according to the predetermined trajectory;

receiving data gathered during the construction of the borehole;

5 comparing the predicted failure conditions with a diagnoses of the borehole based on the received data to identify at least one inconsistency;

10 selecting a component of the earth model that is related to the identified inconsistency and has a high degree of uncertainty;

updating the selected component of the earth model prior to completion of the borehole using the received data; and

15 thereafter drilling a further portion of the borehole using the earth model including the updated component.

13. The method of claim 12 further comprising repeating the steps of predicting, comparing, selecting and updating until a sufficient match exists between the predicted failure conditions and the diagnoses of the borehole.

25 14. The method of claim 13 wherein the step of combining when repeated uses the updated component of the earth model, and the step of selecting when being repeated, considers components that have been recently updated as having a lower degree of uncertainty.

15. The method of claim 12 wherein the step of selecting a component comprises:

5                   identifying components of the earth model that are relevant to the identified inconsistency; and

                  ranking the identified components according to the degree of uncertainty.

16. The method of claim 12 wherein the step 10 of updating comprises effecting the minimum practical changes to the selected component that eliminates an identified inconsistency.

17. The method of claim 12 wherein the 15 received data includes the effective density of the drilling fluid used in the construction of the borehole and one at least other parameter, and the step of updating comprises updating the selected component using the effective density and the at least one other 20 parameter.

18. A computer readable medium that is capable of causing a computer to perform steps comprising:

25                   obtaining an earth model used for predicting potential problems in drilling of a borehole having a predetermined trajectory, the earth model comprising a number of components;

30                   obtaining evaluations of the state of the borehole and local geological features, the evaluations being based on the earth model;

receiving data gathered during the construction of the borehole;

5 comparing the evaluations with a diagnosis of the state of the borehole and local geological features to identify at least one inconsistency, the diagnosis being based on the received data;

selecting a component of the earth model that is related to the identified inconsistency and has a high degree of uncertainty; and

10 updating the selected component of the earth model prior to completing construction of the borehole using the received data.

19. The computer readable medium of claim 18  
15 capable of causing a computer to perform steps further comprising:

identifying components of the earth model that are relevant to the identified inconsistency; and

20 ranking the identified components according to the degree of uncertainty.

20. The computer readable medium of claim 19  
wherein the step of updating comprises effecting the  
25 minimum practical changes to the selected component  
that eliminates an identified inconsistency.

21. The computer readable medium of claim 20  
wherein the received data includes the effective  
30 density of the drilling fluid used in the construction  
of the borehole and one at least other parameter, and

the step of updating comprises updating the selected component using the effective density and the at least one other parameter.